EFFECT OF THE TELLURIUM FOR SELENIUM SUBSTITUTION ON THE PHASE COMPOSITION AND ELECTRICAL RESISTIVITY OF $FE_7(SE_{1-X}TE_X)_8$

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The discovery of Fe(Se, Te)-type superconductors has attracted much attention due to their simplest crystal structure among the new families of iron-based layered compounds. However, the Fe(Se, Te) samples often exhibit an impurity hexagonal phase of the NiAs-type together with the main superconducting phase having a tetragonal PbO-type phase [1]. The aim of the present work is to study how the coexistence of the tetragonal and hexagonal phases in the $Fe_7(Se,Te)_8$ samples influences their superconducting properties bearing in mind the limited solubility of tellurium in $Fe_7(Se,Te)_8$.

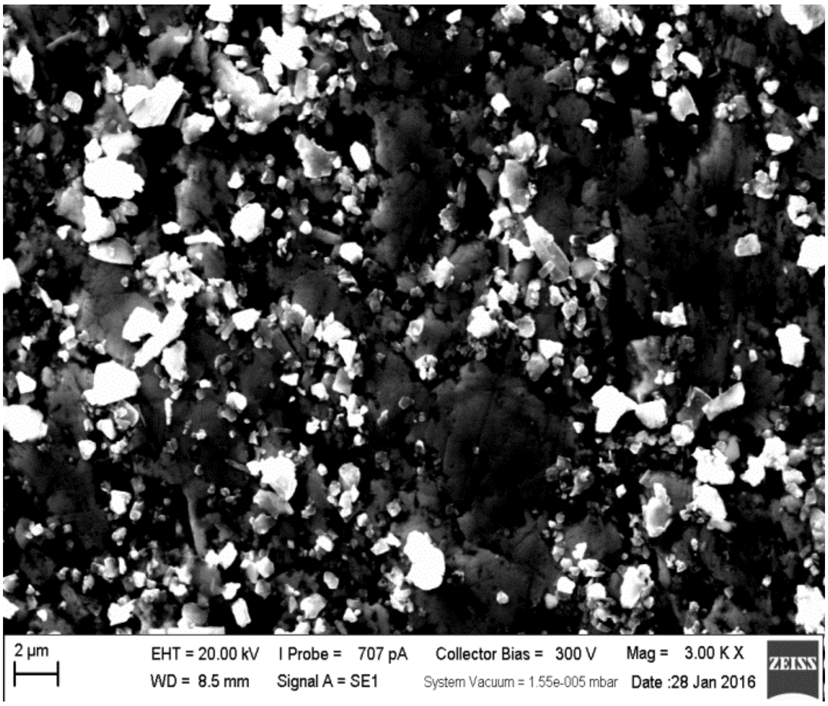

Fig. 1 The SEM image for $Fe_7(Se_{0.7}Te_{0.3})8$ sample after annealing at 200 °C for two weeks

Two coarse-grained samples with nominal compositions $Fe_7(Se_{0.7}Te_{0.3})_8$ and $Fe_7(Se_{0.6}Te_{0.4})_8$ were prepared by melting at 900 °C and then annealed at 200 °C for two weeks. The synthesized samples were studied by means of X-ray diffraction, electrical resistivity, scanning electron microscopy (SEM) and magnetic susceptibility measurements. As it turned out, the substitution of tellurium for selenium in $Fe_7(Se_{1-x}Te_x)_8$ leads to the appearance of the tetragonal PbO-type phase (space group

P4/nmm) at $x > 0.2$. According to X-ray diffraction the volume of the tetragonal phase increases after annealing at 200 °C. The measurements of the electrical resistivity have revealed that the samples containing PbO-type phase exhibit the phase transition to the superconducting state. The SEM image for $Fe_7(Se_{0.7}Te_{0.3})8$ sample after annealing at 200 °C for two weeks is shown in Fig.1. The sample demonstrates two phases: the hexagonal $Fe_7(SeTe)_8$ phase (black regions) and tetragonal Fe(SeTe) phase (white regions). We found that the volume of tetragonal phase, the critical temperature T_c and the resistivity behavior of the $Fe_7(Se_{1-x}Te_x)_8$ samples depend on the tellurium content and heat-treatment conditions.

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1. Pomjakushina E. et al., Physical Review B 80, 024517(2009).

ФЛУКТУАЦИОННАЯ ТЕОРЕМА И МОДЕЛЬ ЭРЕНФЕСТОВ-КЛЕЙНА

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FLUCTUATION THEOREM AND THE EHRENFEST-KLEIN URN MODEL

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The validity of fluctuation theorem has been studied on the Ehrenfest-Klein urn model. Chemical interpretation of the Ehrenfest-Klein urn model is given. Analytical and computer study of this model allows testing fluctuation theorem in thermodynamic limit and checking equivalence between dissipation function and entropy production.

В последние два десятилетия развитие получила группа теорем, известных под именем флуктуационных. В самом простом виде флуктуационную теорему можно сформулировать следующим образом [1]: положительная диссипация, которая приближает систему к равновесию, экспоненциально более вероятна, чем отрицательная диссипация, отклоняющая систему в сторону большей неравновесности [3]. Ключевой величиной в флуктуационной теореме является диссипативная функция Ω. Зачастую в литературе в качестве диссипативной функции Ω рассматривают термодинамическое производство энтропии Σ. Целью работы являлась проверка правомерности такого отождествления на модели Эренфестов-Клейна по аналогии с тем, как это было сделано ранее для модельной реакции Шлегля [2].